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APPLICATION FOR PATENT

ON

AIR COMPRESSOR ASSEMBLY WITH CONTINUOUS AUTO DRAIN TANK

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AIR COMPRESSOR ASSEMBLY WITH CONTINUOUS AUTO DRAIN TANK

CROSS-REFERENCE TO RELATED DOCUMENTS

[0001] The present application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Application Serial No. 60/408,860, filed September 6, 2002. Said U.S. Provisional Application Serial No. 60/408,860 is herein incorporated by reference in its entirety.

[0002] The present application herein incorporates the following United States Patent Applications by reference in their entirety:

Attorney Docket Number	"Express Mail" Mailing Label No.	Filing Date
PTG 02-96-3	EV 338 284 614 US	June 20, 2003
PTG 02-96-4	EV 338 284 605 US	June 20, 2003

FIELD OF THE INVENTION

[0003] The present invention relates generally to the field of air compressors, and particularly to an air compressor assembly having an air tank which automatically and continuously discharges condensate accumulated in the air tank during air usage.

BACKGROUND OF THE INVENTION

[0004] An air compressor assembly is used to provide compressed air for operating air powered tools such as nailing tools, socket driving tools, material shaping tools, sanding tools, spray painting tools, inflation chucks, and the like. During the utilization of an air compressor assembly, moisture in compressed air may build up at the bottom of an air tank of an air compressor assembly. Since condensate accumulation in the air tank, if not drained timely, may cause tank corrosion, a drain valve is conventionally provided at the bottom of the air tank to open up after a certain operating time of the air compressor assembly to release condensate (e.g.,

condensed moisture) accumulated therein. Such a drain valve requires constant monitoring, must be attended by a dedicated person, and is therefore not practical in terms of labor cost and working efficiency.

[0005] Thus, it would be desirable to provide an air compressor assembly that is free from the drain valve, requires less maintenance time, and has less tank corrosion.

SUMMARY OF THE INVENTION

[0006] Accordingly, the present invention is directed to an air compressor assembly having an air tank which, during air usage, continuously discharges condensate accumulated in the air tank into the compressed air being released for use in air powered tools.

[0007] In one embodiment of the present invention, the air tank has an air outlet port, through which compressed air and discharged condensate may be released from the air tank.

[0008] In a further embodiment of the present invention, the air tank has a centrally hollow conduit inside the air tank through which compressed air and discharged condensate may be released from the air tank. The conduit, whose top open end is an air outlet port of the air tank, protrudes downward from the air outlet and has a lower open end positioned in a vicinity of the bottom of the air tank.

[0009] According to the present invention, during air usage, the compressed air being released may push condensate out of the tank through the air outlet or through the conduit. The compressed air being released may mix with the discharged condensate and be used in air powered tools. Because condensate within the air tank is continuously discharged during air usage, the condensate may be discharged in small amounts not harmful to the air powered tools.

[0010] The air tank according to the present invention may be part of air compressor assemblies in various styles, including a "pancake" type air compressor assembly, a "hot-dog" type air compressor assembly, a vertical "hot-dog" type air compressor assembly, a vertical stationary type air compressor assembly, a "double hot-dog" type air compressor assembly, and the like.

[0011] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention as claimed. The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate an embodiment of the invention and together with the general description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The numerous advantages of the present invention may be better understood by those skilled in the art by reference to the accompanying figures in which:

FIG. 1 is an isometric view illustrating a portable air compressor assembly in accordance with an exemplary embodiment of the present invention;

FIG. 2 is a front elevation view of the portable air compressor assembly shown in FIG. 1;

FIG. 3 is a side elevation view of the portable air compressor assembly shown in FIG. 1;

FIG. 4 is an isometric view of an exemplary embodiment of the portable air compressor assembly shown in FIGS. 1 through 3, wherein the front shell of the shroud is removed for illustration of the air tank, air compressor and manifold assembly;

FIG. 5 is an isometric view of the portable air compressor assembly shown in FIG. 4, further illustrating manifold assembly, air compressor, and the air tank within

the shroud of the portable air compressor assembly, wherein the air tank is shown in a cross-sectional view;

FIG. 6 is an isometric view of a further exemplary embodiment of the portable air compressor assembly shown in FIGS. 1 through 3, wherein the front shell of the shroud is removed for illustration of the air tank, air compressor and manifold assembly;

FIG. 7 is an isometric view of the portable air compressor assembly shown in FIGS. 6, further illustrating manifold assembly, air compressor, and the air tank within the shroud of the portable air compressor assembly, wherein the air tank is shown in a cross-sectional view;

FIG. 8 is an isometric view of an additional exemplary embodiment of the portable air compressor assembly shown in FIGS. 1 through 3, wherein the front shell of the shroud is removed for illustration of the air tank, air compressor and manifold assembly;

FIG. 9 is an isometric view of the portable air compressor assembly shown in FIGS. 8, further illustrating manifold assembly, air compressor, and the air tank within the shroud of the portable air compressor assembly, wherein the air tank is shown in a cross-sectional view;

FIG. 10 is an isometric view illustrating a "pancake" type air compressor assembly in accordance with an exemplary embodiment of the present invention;

FIG. 11 is an isometric view illustrating a "hot dog" type air compressor assembly in accordance with an exemplary embodiment of the present invention;

FIG. 12 is an isometric view illustrating a vertical "hot dog" type air compressor assembly in accordance with an exemplary embodiment of the present invention; and

FIG. 13 is an isometric view illustrating a vertical stationary type air compressor assembly in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Reference will now be made in detail to the presently preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings.

[0014] Referring generally now to FIGS. 1 through 9, exemplary embodiments of a portable air compressor assembly 100 in accordance with the present invention are shown. It is understood that a portable air compressor assembly means an air compressor assembly that can be carried and/or moved with ease, and not as a structural limitation. The portable air compressor assembly 100 includes an air tank 102 (or 202), an air compressor 104, and a manifold assembly 106 assembled within a shroud or housing 108. The shroud 108, which is preferably formed of plastic, may include a handle 118 allowing an operator to lift and transport the portable air compressor assembly 100 from place to place, and a control panel 120 for providing controls for the portable air compressor assembly 100.

[0015] In the exemplary embodiments illustrated in FIGS. 1 through 3, the control panel 120 may include an on/off switch 122, a pressure regulator 124, a pressure gauge 126, a pressure relief safety valve 128, and a speed control switch 116. However, it is understood that the control panel 120 may provide other controls depending on design preferences.

[0016] As shown in FIGS. 4 through 9, the air compressor 104 may include a compressor 110 having one or more pistons 112 driven by a motor or engine 114. For example, in the exemplary embodiments illustrated, the air compressor 104 may include a single piston compressor 110 having a single piston driven by a universal electric motor 114. By employing a universal electric motor 114, the speed at which the motor 114 operates, and thus the speed at which the piston 112 is reciprocated, may be varied by controlling the voltage supplied to the motor 114. In this manner, the air flow rate supplied by the air compressor 104 through connecting piping or

tubing 136 and/or manifold assembly 106 to the air tanks 102, 202 may be varied. For example, in the embodiments illustrated, the speed control switch 116 shown in FIGS. 1 and 2 may allow an operator to select between a high speed operation mode wherein maximum air flow is supplied to the air tanks 102, 202, and a low speed operating mode wherein the compressor 110 runs more slowly reducing the noise generated by the air compressor 104.

[0017] FIG. 4 is an isometric view of an exemplary embodiment of the portable air compressor assembly 100 shown in FIGS. 1 through 3, wherein the front shell of the shroud 108 is removed. FIG. 5 is an isometric view of the portable air compressor assembly 100 shown in FIG. 4, wherein the air tank 102 is shown in a cross-sectional view.

[0018] As shown in FIGS. 4 and 5, the air tank 102 of the air compressor assembly 100 has an air inlet port 130 and an air outlet port 132, both positioned at the wall of the air tank 102. In the exemplary embodiments shown in FIGS. 4 and 5, the air inlet port 130 is located at an upper wall of the air tank 102, and the air outlet port 132 is located at a lower wall of the air tank 102. It is understood that the locations of the air inlet port 130 and the air outlet port 132 at the wall of the air tank 102 may change, without departing from the scope and spirit of the present invention. The air inlet port 130 and the air outlet port 132 are openings extending through the wall of the air tank 102.

[0019] As shown in FIGS. 4 and 5, the air compressor 104 may provide air to the air tank 102 through the tubing 136 and the air inlet port 130. There may exist a check valve (not shown) inside the air inlet port 130, which allows air to flow from the air compressor 104 to the air tank 102 but prevents air from flowing from the air tank 102 to the air compressor 104. The air tank 102 may be connected to the manifold assembly 106 through outlet tubing 134. During air usage, compressed air being

released from the air tank 102, because of its high pressure, may drive condensate accumulated in the tank 102 out through the air outlet port 132. The compressed air being released may mix with the discharged condensate and be used in air powered tools. Preferably, the discharged condensate is routed through the outlet tubing 134, the manifold assembly 106 and any attached air hose to the air powered tools.

[0020] FIG. 6 is an isometric view of a further exemplary embodiment of the portable air compressor assembly 100 shown in FIGS. 1 through 3, wherein the front shell of the shroud 108 is removed. FIG. 7 is an isometric view of the portable air compressor assembly 100 shown in FIGS. 6, wherein the air tank 202 is shown in a cross-sectional view.

[0021] As shown in FIGS. 6 and 7, the air tank 102 of the air compressor assembly 100 has an air access port 132 positioned at the wall of the air tank 102. In the exemplary embodiments shown in FIGS. 6 and 7, the air access port 132 is located at a lower wall of the air tank 102. It is understood that the location of the air access port 132 at the wall of the air tank 102 may change, without departing from the scope and spirit of the present invention. The air access port 132 is an opening extending through the wall of the air tank 102.

[0022] As shown in FIGS. 6 and 7, the air compressor 104 is connected to the manifold assembly 106 through the tubing 136, and the air tank 102 is connected to the manifold assembly 106 through the air access port 132 and tubing 134. There may exist a check valve (not shown) inside the manifold assembly 106, which allows air to flow from the air compressor 104 to the manifold assembly 106 but prevents air from flowing from the manifold assembly 106 to the air compressor 104. Thus, the air compressor 104 may supply air to the air tank 102 through the tubing 136, the manifold assembly 106, the tubing 134 and the air access port 132. Compressed air may be released from the air tank 102 through the air access port 132, the tubing 134,

the manifold assembly 106, and any attached air hose to the air powered tools. During air usage, compressed air being released from the air tank 102, because of its high pressure, may drive condensate accumulated in the tank 102 out through the air access port 132. The compressed air being released may mix with the discharged condensate and be used in air powered tools.

[0023] FIG. 8 is an isometric view of an additional exemplary embodiment of the portable air compressor assembly shown in FIGS. 1 through 3, wherein the front shell of the shroud is removed for illustration of the air tank, air compressor and manifold assembly. FIG. 9 is an isometric view of the portable air compressor assembly shown in FIGS. 8, further illustrating manifold assembly, air compressor, and the air tank within the shroud of the portable air compressor assembly, wherein the air tank is shown in a cross-sectional view;

[0024] As shown in FIGS. 8 and 9, the air tank 202 of the air compressor assembly 100 may have an air access port 150 (often referred to as a "spud") positioned at a wall of the air tank 202. For example, in the exemplary embodiments, the air access port 150 is located at an upper wall of the air tank 202. However, it is understood the air access port 150 may be located at a different position at the wall of the air tank 202, without departing from the scope and spirit of the present invention. The air access port 150 is an opening that extends through the wall of the air tank 202.

[0025] As shown in FIG. 8, the air access port 150 is connected to a pressure switch assembly 118 which in turn is connected to the manifold assembly 106 via connecting pipe or tubing 116. The pressure switch assembly 118 is used for regulating pressure within the air tank 202 by alternately starting and stopping the air compressor 104 to periodically replenish the supply of air in the tank 202. When pressure within the tank 202 reaches a preset low pressure point, or "kick-in pressure", the pressure switch assembly 118 starts the air compressor 104 to re-pressurize the tank 202. As

the pressure within the tank 202 reaches a preset high pressure point, or "kick-out pressure", the pressure switch assembly 118 stops the air compressor 104 to prevent over-pressurization of the tank 202. In this manner, the pressure of the compressed air in the compressed air storage tank 202 is maintained within a range generally suitable for powering one or more air powered tools.

[0026] As shown in FIG. 9, the air access port 150 is an upper open end of a centrally hollow conduit 138 which is located inside the air tank 202. The conduit 138 protrudes downward from the air access port 150 and has a lower open end 140 positioned in a vicinity of the bottom of the air tank 202. Through the air access port 150 and the conduit 138, compressed air may be provided to the air tank 202 by the air compressor 104. For example, the air compressor 104 may supply air to the air tank 202 through the tubing 136, the manifold assembly 106, the connecting tubing 116, the pressure switch assembly 118, the air access port 150, and the conduit 138. There may exist a check valve (not shown) inside the manifold assembly 106, which allows air to flow from the air compressor 104 to the manifold assembly 106 but prevents air from flowing from the manifold assembly 106 to the air compressor 104.

[0027] Compressed air may be released from the air tank 102 through the conduit 138, the air access port 150, the connecting tubing 116, the pressure switch assembly 118, the manifold assembly 106, and any attached air hose to the air powered tools. During air usage compressed air being released from the air tank 202, because of its high pressure, may push condensate accumulated inside the air tank 202 out through the lower open end 140, the conduit 138 and the air access port 150. The compressed air being released may mix with the discharged condensed moisture and be used in air powered tools.

[0028] As shown in FIGS. 1 through 9, because condensate within the air tanks 102, 202 is continuously discharged during air usage, the condensate is discharged in small

amounts not harmful to the air tool. Accordingly, the air tanks 102, 202 do not require a drain valve such as is commonly found in the air tanks of conventional air compressor assemblies for draining condensate from the tank. Thus, the drain valve may be eliminated. Furthermore, the time required for maintenance of the air compressor assembly 100 is reduced compared to that of a conventional air compressor assembly, since the air tanks 102, 202 do not have to be manually drained on a periodic basis. Moreover, tank corrosion is reduced because condensate removal is continuous and not dependent on operator maintenance actions.

[0029] In the exemplary embodiments illustrated in FIGS. 1 through 9, if moisture-free air is required (e.g., for paint spraying or the like), a moisture separator may be coupled to an air hose that is connected to the air compressor assembly 100. However, such moisture separators are also required by a conventional air compressor assembly for applications such as paint spraying, since it is known that moisture condenses in air hoses as well as in the air tank of a compressor assembly. Thus, compared to a conventional air compressor assembly, the air compressor assembly 100 of the present invention would require no additional equipment if used for applications requiring removal of moisture (e.g., such as providing air to spray paint).

[0030] In the exemplary embodiments illustrated in FIGS. 1 through 9, the air tanks 102, 202 are enclosed within and supported by the shroud 108. The shroud 108 may also enclose the air compressor 104, the manifold assembly 106, the connecting piping or tubing 136, and electrical wiring. Because the air tanks 102, 202 are typically not visible to viewers of the shroud 108 from outside of the assembled shroud, the air tanks 102, 202 may be fabricated and assembled into the unit without first being painted. In this manner, processing through an expensive and time consuming paint process is eliminated, improving manufacturing efficiencies to lower cost. Moreover, all potentially hot tubing between the air compressor 104 and the air tanks 102, 202 is enclosed in the shroud 108, thereby reducing the risk of operator

burn injuries from hot tubing surfaces. An additional advantage of the enclosed air tanks 102, 202 is that the air tanks 102, 202 may warm up more quickly than an exposed tank by absorbing heat from the air compressor 104. The air tanks 102, 202 may also retain heat longer because of reduced convection and radiation cooling to the outside air. By keeping the air tanks 102, 202 warmer, the tanks 102, 202 are less likely to condense moisture, resulting in reduced tank corrosion.

[0031] Referring generally now to FIGS. 10 through 13, exemplary embodiments of air compressor assemblies in various styles in accordance with the present invention are shown. Referring to FIG. 10, an exemplary "pancake" type air compressor assembly 800 in accordance with the present invention is shown. The air compressor assembly 800 may include an air tank 802, an air compressor 804, and a manifold assembly 806. The air tank 802 is a flattened oval tank, often referred to informally in the art as a "pancake" style tank. The air tank 802 may be made of plastic, metal such as steel, or the like. The air tank 802 has an air inlet port which is connected to the air compressor 804 through tubing 834. There may exist a check valve (not shown) inside the air inlet port, which allows air to flow from the air compressor 804 to the air tank 802 but prevents air from flowing from the air tank 802 to the air compressor 804. An air outlet port 832 is located at the wall of the air tank 802. Preferably, air outlet port 832 is located at the bottom of the air tank 802. The air outlet port 832 is an opening that extends through the tank wall and is connected to the manifold assembly 806 through outlet tubing. The air compressor assembly 800 may also include a wheel assembly 860 for transporting the air compressor assembly 800.

[0032] Referring to FIG. 11, an exemplary "hot-dog" type air compressor assembly 900 in accordance with the present invention is shown. The air compressor assembly 900 may include an air tank 902, an air compressor 904, and a manifold assembly 906. The air tank 902 is a horizontally disposed, cylindrical compressed air tank,

typically referred to informally in the art as a "hot-dog" style tank. The air tank 902 may be made of plastic, metal such as steel, or the like. The air tank 902 has an air inlet port which is connected to the air compressor 904 through tubing 934. There may exist a check valve (not shown) inside the air inlet port, which allows air to flow from the air compressor 904 to the air tank 902 but prevents air from flowing from the air tank 902 to the air compressor 904. An air outlet port 932 is located at the wall of the air tank 902. Preferably, air outlet port 932 is located at the bottom of the air tank 902. The air outlet port 932 is an opening that extends through the tank wall and is connected to the manifold assembly 906 through outlet tubing. The air compressor assembly 900 may also include a wheel assembly 960 for transporting the air compressor assembly 900.

[0033] Referring to FIG. 12, an exemplary vertical "hot-dog" type air compressor assembly 1000 in accordance with the present invention is shown. The air compressor assembly 1000 may include an air tank 1002, an air compressor 1004, and a manifold assembly 1006. The air tank 1002 is a vertically disposed, cylindrical compressed air tank, typically referred to informally in the art as a vertical "hot-dog" style tank. The air tank 1002 may be made of plastic, metal such as steel, or the like. The air tank 1002 has an air inlet port which is connected to the air compressor 1004 through tubing 1034. There may exist a check valve (not shown) inside the air inlet port, which allows air to flow from the air compressor 1004 to the air tank 1002 but prevents air from flowing from the air tank 1002 to the air compressor 1004. An air outlet port 1032 is located at the wall of the air tank 1002. Preferably, air outlet port 1032 is located at the bottom of the air tank 1002. The air outlet port 1032 is an opening that extends through the tank wall and is connected to the manifold assembly 1006 through outlet tubing. The air compressor assembly 1000 may also include a wheel assembly 1060 for transporting the air compressor assembly 1000.

[0034] Referring to FIG. 13, an exemplary vertical stationary type air compressor assembly 1100 in accordance with the present invention is shown. The air compressor assembly 1100 may include a vertically disposed air tank 1102, an air compressor 1104, and a manifold assembly 1106. The air compressor assembly 1100 is stationary, that is, it may not be easily transported. The air tank 1102 may be made of plastic, metal such as steel, or the like. The air tank 1102 has an air inlet port which is connected to the air compressor 1104 through tubing 1134. There may exist a check valve (not shown) inside the air inlet port, which allows air to flow from the air compressor 1104 to the air tank 1102 but prevents air from flowing from the air tank 1102 to the air compressor 1104. An air outlet port 1132 is located at the wall of the air tank 1102. Preferably, air outlet port 1032 is located at the bottom of the air tank 1002. The air outlet port 1132 is an opening that extends through the tank wall and is connected to the manifold assembly 1106 through outlet tubing.

[0035] In the exemplary embodiments illustrated in FIGS. 10 through 13, the air compressors 804, 904, 1004, 1104 may provide air to the air tanks 802, 902, 1002, 1102 through tubing 834, 934, 1034, 1134, respectively. During air usage, compressed air being released from the air tanks 802, 902, 1002, 1102, because of its high pressure, may drive condensate accumulated in the tanks 802, 902, 1002, 1102 out through the air outlet ports 832, 932, 1032, 1132, respectively. The compressed air being released may mix with the discharged condensate and be used by air powered tools.

[0036] It is understood that the air tanks 802, 902, 1002, 1102 of the air compressor assemblies 800, 900, 1000, 1100 may have the configuration shown in FIGS. 6 and 7, without departing from the scope and spirit of the present invention. That is, instead of having an air inlet port and a separate air outlet port, the air tank may have a single air access port, through which air may be supplied to the air tank from the air

compressor, and compressed air and condensate accumulated in the air tank may be released for use by air tools.

[0037] It is understood that the air tanks 802, 902, 1002, 1102 of the air compressor assemblies 800, 900, 1000, 1100 may have the configuration shown in FIGS. 8 and 9, without departing from the scope and spirit of the present invention. That is, the air tank may have a centrally hollow conduit located inside the air tank. Through the conduit, compressed air may be supplied to the air tank from the air compressor, and compressed air and condensate accumulated in the air tank may be released for use by air tools.

[0038] In the exemplary embodiments illustrated in FIGS. 10 through 13, because condensate within the air tanks 802, 902, 1002, 1102 is continuously discharged during air usage, the condensate is discharged in small amounts not harmful to the air tool. Accordingly, the air tanks 802, 902, 1002, 1102 do not require a drain valve such as is commonly found in the air tanks of conventional air compressor assemblies for draining condensate from the tank. Thus, the drain valve may be eliminated. Furthermore, the time required for maintenance of the air compressor assembly 800, 900, 1000, 1100 is reduced compared to that of a conventional air compressor assembly, since the air tanks 802, 902, 1002, 1102 do not have to be manually drained on a periodic basis. Moreover, tank corrosion is reduced because condensate removal is continuous and not dependent on operator maintenance actions.

[0039] In the exemplary embodiments illustrated in FIGS. 10 through 13, if moisture-free air is required (e.g., for paint spraying or the like), a moisture separator may be coupled to an air hose that is connected to the air compressor assembly 800, 900, 1000, 1100. However, such moisture separators are also required by a conventional air compressor assembly for applications such as paint spraying, since it is known that moisture condenses in air hoses as well as in the air tank of a compressor assembly.

Thus, compared to a conventional air compressor assembly, the air compressor assembly 800, 900, 1000, 1100 of the present invention would require no additional equipment if used for applications requiring removal of moisture (e.g., such as providing air to spray paint).

[0040] It is understood that the air compressor assembly according to the present invention may also have air tanks of other configurations without departing from the scope and spirit of the present invention. For example, it may have two horizontally disposed cylindrical compressed air tanks, positioned side by side in a vertically oriented "double hot-dog" configuration.

[0041] It is also understood that the specific order or hierarchy of steps in the methods disclosed are examples of exemplary approaches. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the method can be rearranged while remaining within the scope of the present invention. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

[0042] It is believed that the present invention and many of its attendant advantages will be understood by the foregoing description. It is also believed that it will be apparent that various changes may be made in the form, construction and arrangement of the components thereof without departing from the scope and spirit of the invention or without sacrificing all of its material advantages, the form herein before described being merely an explanatory embodiment thereof. It is the intention of the following claims to encompass and include such changes.